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ORIGINAL ARTICLES.

ORIGINAL INVESTIGATIONS ON THE NATURAL HISTORY, (SYMPTOMS AND PATHOLOGY) OF YELLOW FEVER. 1854–1894.

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Yellow fever (vomito; vomito prieto; vomito negro, fièvre matelotte; febris flava; fièvre jaunne; gelbes fieber; febbre grilla; febris icterodes; typhus icterodes; typhus tropicus; typhus d' Amérique; fiebre amarilla; coap de banc; febris maligna biliosa Americana flava; bulam fever; hemogastric pestilence; pestilentia hemogastrica; synochus icterodes; causus; febris flava Americanorum, epanetus malignus flavus; typhus jaune; ichwaites erbrechen westendisches fieber; fiebre yialla; black vomit; malignant yellow fever; pestilential fever; epidemic yellow fever; specific yellow fever.)

DEFINITION.

A pestilential fever, of a continuous and specific type, originally developed in tropical and insular America; confined to definite geographical limits, and dependent in its origin and spread upon definite degrees of temperature, and capable of transportation and propagation on ships and in towns and cities in those portions of North and South America which lie between 45° N. latitude and 35° S. latitude. The disease has been limited chiefly to the coast of tropical America, rather from the number and position of the commercial centers, than from any climatic causes adverse to its propagation elsewhere. It has been imported chiefly from the Antilles, and from the cities of tropical America by ships into the Gulf and Atlantic cities of the United States, and into Cadiz, Carthagena, Barcelona, Gibraltar, Lisbon, Saint Nazain in the department of the lower Loire, and into Plymouth and Southampton in Europe; and it has been imported and become epidemic as far south as Montevideo and Buenos Ayres in South America. As a general rule, it has originated and become endemic in cities situated in low, unhealthy malarious districts on the sea or river coasts of insular and tropical America, and has rarely occurred at an elevation of 2,500 feet above the level of the sea; in Jamaica it has prevailed at Stoney Hill, 1,300 feet above the sea, and at Newcastle 4,000 feet above the sea; according to Alexander Humboldt, it has never ascended in Mexico to 3,044 feet above the level of the sea, below which limit the Mexican oaks do not flourish, showing that the constant average temperature below this is of a tropical character.

In the United States the disease has never in its epidemic form reached an elevation of 500 feet, and it has been observed that its epidemic course or limit coincides to a certain extent with the range of the growth of the live-oak, the cypress and the long moss. The inhabitants of the barren rock of Gibraltar, at an elevation of between 1,400 and 1,439 feet above the level of the sea, have been desolated by this disease upon more than one occasion. It is certain that yellow fever has prevailed in the celebrated table land of Caracas, 3,000 feet above the level of the sea. In the remarkable epidemic of yellow fever which prevailed in Peru in 1855 and 1856, the disease passed over the barrier of the Andes, committing fearful ravages in Andine and trans-Andine regions, at elevations of 14,000 feet above the level of the sea. The stereotyped expressions of systematic writers, as to the limitation of yellow fever to certain elevations and to the sea and river coasts must in the light of the preceding facts be abandoned.

Yellow fever presents two well defined stages; the first characterized by severe pains in the head, confined chiefly to the orbits and forehead, back and lower extremities, a peculiar shining or drunken appearance in the eyes, rapid circulation, elevated temperature, and increase of those constituents as urea, uric acid, phosphoric acid and sulphuric acid which result from the increased chemic changes induced by the febrile poisons; and which stage may extend from 36 to 150 hours, without any distinct remissions, according to the severity of the disease; the second characterized by depression of the nervous and muscular forces, and of the general and capillary circulation, capillary congestion, slow and intermittent pulse, jaundice, a purplish and yellowish mottled appearance of the surface, urinary suppression, albuminous urine loaded with granular casts of the urinary tubes, fatty degeneration of the heart, liver and kidneys, defibrination of the blood, passive hemorrhages from ears, stomach and bowels, nares, tongue, gums, uterus, vagina, gall bladder and anus, and in extreme cases from the eyes, ears and skin, black vomit, interstitial hemorrhages, delirium, convulsions and coma. In its origin and propagation, it appears not to be dependent on those conditions and causes, which generate malarial paroxysmal fever, from which it differs essentially in symptoms and pathology.

One of the prominent symptoms of the first stage is that rapid increase of the pulse, within the first few hours of the febrile excitement, and the progressive diminution of the beats of the heart, even while the temperature progressively rises; and in like manner, the slow and feeble action of the heart constitutes a prominent and striking symptom of the second stage. Yellow fever, in common with such contagious diseases as smallpox, measles and scarlet fever occurs as a general rule, but once during life, and may be propagated by contagion; it differs, however, from the exanthematous diseases, in that it has never been known to propagate beyond 48° N., and 38° S. latitude, nor below a temperature of 65 degrees F. The symptoms of yellow fever may be divided for description and investigation into:

1. Those manifested during the period of incuba-

John Hunter, R. Jackson, Wallace, Riseuno, Moreau de Jennès, Rush, Townsend, Chisholm, Bryson, might be adduced to sustain the proposition already sufficiently illustrated by the authorities quoted, that the period of incubation of yellow fever is of variable duration. From the preceding facts, the following conclusions may be drawn:

1. Yellow fever differs from such contagious diseases as smallpox, measles and scarlet fever, in the variable duration of the period of incubation.

2. The sudden seizure of many cases after a few hours exposure to the infected atmosphere, indicates the existence in the air of a potent and specific poison, which is most probably introduced through the lungs into the blood.

3. The phenomena of yellow fever in those suddenly exposed to the atmosphere of an infected locality can not be referred to any physical changes of the temperature and electrical condition of the surrounding atmosphere, but must be referred to the action of a specific poison.

4. The propagation of yellow fever from the infected atmosphere of an infected vessel in a healthy city; the communication of the yellow fever from person to person; the spread of the disease from an infected point in a city, however large, over extended areas of said city; and the sudden cessation of epidemics of yellow fever by cold sufficient to produce frost and ice. These and similar facts indicate that the poison of yellow fever is a living germ of animal or vegetable nature or origin.

(To be continued.)

CRANIOPLASTIC OPERATIONS.

Thesis: For admission to Chicago Academy of Medicine.

BY CARL BECK, M.D.
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The purpose of plastic operations is to remedy defects. Cranioplastic operations have, therefore, to remedy defects of the cranium. The cranium is a bony structure, and operations on such are therefore bone-plastic operations and share more or less of the characteristics, difficulties and the fate of such.

Bone-plastic has been studied attentively of late, but osteoplastic on the cranium has not been the subject of very critical research.

Defects of the cranium can be either congenital or acquired. Teratology and pathology enumerate a large number of instances of such congenital defects. From the monster called anencephalus, hemicephalus, down to porencephalus, through all gradations we have mal-development of the cranium, but these extremely high degrees of defects will not easily be the subjects of a plastic. The individuals thus born are doomed to die early, or they are idiots and not worthy of remedy—for such a creature it is better to be dead than alive. But there are defects of the cranium which allow a normal development of the brain. Such are small defects in the bony part, as present in meningo- or encephalocele—small openings in the skull. Such defects are especially concerned in plastic.

A much larger group than the congenital is the acquired. They can be acquired by trauma or disease. This trauma can either be caused by accident or purpose, and the latter furnishes, with the growing number of surgical operations on the skull and brain, the largest amount of defects. Various diseases may destroy the cranium, and not only the size of the defect in a particular case, but the peculiarity of the disease must be taken into consideration.

After thus reviewing the possibilities of defects from the etiologic standpoint, we will divide the defects into:

1. Congenital.
2. Accidental trauma.
3. Surgical.
4. Morbid.
   - (*a*) Tubercular.
   - (*b*) Syphilitic.
   - (*c*) Cancerous or sarcomatous.

I—CONGENITAL DEFECTS.

Osteoplastic operations, would be considered when a small defect allows the development of a hernia cerebri, meningocele, or encephalocele. A defect of this kind might be situated on any place on the cranium; might be quite large; inaccessible; might be very irregular or small, and almost like an opening made by a trephine. Fig. A, which shows such a defect of the skull, is drawn after a specimen of the Musée Dupuytren. The localities where they are most common are the root of the nose, the external and internal angle of the eye, the orbital, nasal and buccal cavities. Furthermore, between the sutures of the cranium. These defects, if not attacked by the surgeon, will never be covered with bone and they form, therefore, one indication for plastic.

FIG. A.—Defect in skull from encephalocele. (Musée Dupuytren.) Duplay-Rèclus. Tr. de Chirurgie.

II—ACCIDENTAL.

All accidents by which complicated comminutive fractures of the skull occur, whereby a part of the bony structure of the skull is lost or is broken out of the continuity, give rise to such a defect. It is not very common that they heal over without being attacked in some way or other by the surgeon; that is, usually, the surgeon removes loose particles, evens edges and corners so as to make the bony wound smooth, so that they would have to be grouped under the third head.

III—SURGICAL.

Defects produced by the surgeon are such as mentioned above. They are very common. All procedures on the skull, whereby parts have been removed, will have, if plastic is not done, a defect. Every opening of the integral cranium for the purpose of dura- or brain-operations or ligature of vessels, if not repaired by plastic leaves a defect.

IV—MORBID.

Tubercular defects are not very common and not

likely to become the subject of a surgical operation. Syphilitic and cancerous defects might be the subjects of quite an extensive plastic.

We now come to the physiology of the parts concerned. The cranium is a bony structure, very much depending on its periosteum. It is not like all bones, having a periosteal covering not only on its outer side, but also on its inner side, for the dura mater certainly acts as a periosteum. We have many proofs of such action. (*Ollier Traité, Exp. et Clin. de la Regeneration des os*, etc., Vol. I, page 80,) says: "The dura mater is a membrane about which the authors have not agreed. Some want to give it the same quality as the periosteum proper, making an internal periosteum of the cranium of it. Others regard it as having no part in the ossification. The study of its development shows, however, that it is united with the bones of the cranium in a very intimate way during the embryonic stage. Furthermore, it is even the seat of pathologic ossifications. In order to decide this question, we proceeded with this membrane in the same way as with the periosteum and have transplanted the same. On young rabbits, we have removed a part of the dura mater of the convexity immediately after death, and we have transplanted this under the skin of the hip. We have obtained bony tissue, mostly in little disseminated granules, sometimes in a mass of the size of a kernel of corn.

This one experimental fact, and another one which I will mention in the report of my cases (Case Chensik), and furthermore, the fact that we find hyperostosis of the dura mater during pregnancy, the so-called hyperostosis or osteophytæ gravidarum, prove it to evidence that the dura mater is nothing but a periosteum. From this fact we draw the conclusion that in doing osteoplastic operations on the cranium we have no difference from other osteoplastic operations, but the fact that it is a combination of a very brittle internal bone-plate, tabula vitrea—and a very hard, somewhat elastic external plate with great individual differences and varieties in circulation, thickness and form, give to this bone an exceptional position.

The question whether we can transfer the results of our experimental work on animals directly to the human, is a very important one. It is a well-known fact that a dog will stand almost any operation on the intestine and survive, while in the human being it shows a different refraction. And so it is with the experiment on the cranium and brain. The cranium of the human especially, is so different from that of other animals, that our experiments, as to technique and peculiarities of healing, can not be immediately transferred nor compared to the human. Some plastic operations (autoplastic) especially, will be much easier on the human than on the animal, while others (heteroplastic) will be just the reverse. It is, therefore, hard to decide about the value of some devices and methods which have been used in experiments on dogs, and not yet been employed on patients.

THE METHODS OF PLASTIC.

Plastic has different methods. The ideal of all plastic is to make it as much as is possible, similar to nature, as we are never able to make it equal to nature, even with our best skill and will. To replace a defect or bone by bone again, of similar size and shape, will therefore be the ideal. This may be accomplished in different ways. Either the bone that has been removed may be replaced right away, with the smallest possible loss of substance, or bone from the same individual, from different parts of his body, may be taken to cover the loss. This procedure is called autoplastic. All the rest of the procedures can be comprised under the name of heteroplastic, and the value of a differentiation between the material—whether from a living subject or whether a dead body—seems to me of little importance, inasmuch as it comes more and more to light that even the transplanted portions from living bodies are not dealt with differently by nature than dead bodies, in the healing process, inasmuch as they all are encysted. It is then only a question, which of those bodies is preferable, and the one that is encysted the quickest and, after encysted, fulfills the purpose of protection the best, is best for transplantation.

We will now go more into the details of these methods.

A—AUTOPLASTY.

1. Temporary Resection.—This would be the simplest method of covering a defect, but it is only applicable where we produce the defect temporarily; therefore, in operations for processes in the dura, the vessels, or the brain, where the cranium is healthy. There

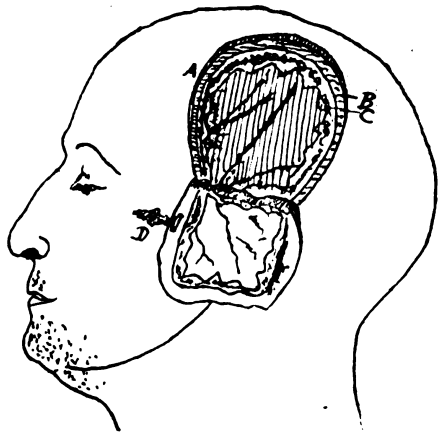


FIG. B.—Temporary resection (Wagner, 1889). A. Incision of the soft parts. B. Space between bony and soft parts. C. Section of bone with both plates. (Chipault.) D. Franck's forceps.

are different methods of temporary resection. One of the first was Wagner's method of skin periosteum bone-flap, in the form of a door of oval shape, with the hinge. It was produced by chisel and mallet.

Usually by this procedure with chisel and mallet (Fig. B.) a great deal of substance of bone is lost, so that the space between the flap and integral bone is left to be filled by cicatrix or a newly formed bone. Modifications of this method are by Müller, Lowenstein, Poirier, Salzer, Bruns, Toison and Chipault. The accompanying figures (Fig C, c_1c_2) explain the more important modifications. Of all the methods that have been described, Chipault's seems to be the most appropriate, inasmuch as it does away with one disadvantage—the lack of apposition of flap and integral bone. Without knowledge of Chipault's method, I have used in a special case, a similar procedure for opening of the skull in the case of a brain tumor but I found that the flap, even then, has been moved so violently by the increased pulsation of the dura that it interfered with the healing, and though the periosteum had been very carefully sutured, two weeks after the operation the flap was

as loose as if it had not been in contact with the bone at all. In order to prevent this, I have studied this question and would suggest a modification of the temporary resection, which I will describe in detail as follows (*vide Centralbl. f. Chir.*, 94, No. 44):

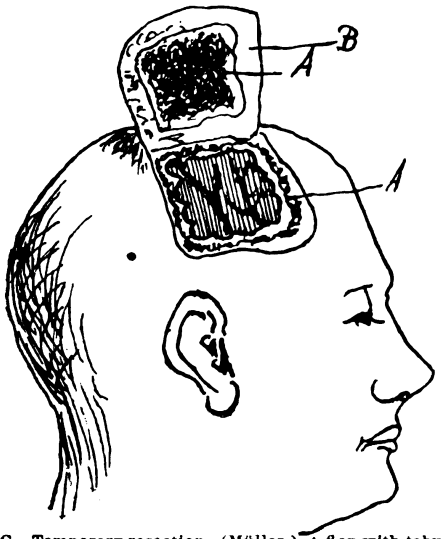


FIG. C.—Temporary resection. (Müller.) A flap with tabula vit. and diploe. B. Soft tissues. The remaining inner table being removed with rougeur.

A more or less rectangular incision with a pedicle in the direction of the larger vessels, is made into the skin and periosteum. The bone is then chiseled in the direction towards the outside, obliquely, through the thickness of the cranium, in the same manner as it is done for Müller-Koënig's osteoplastic, in three directions until the diploë is reached. The edges of the bone, which have been chiseled, are tilted up in

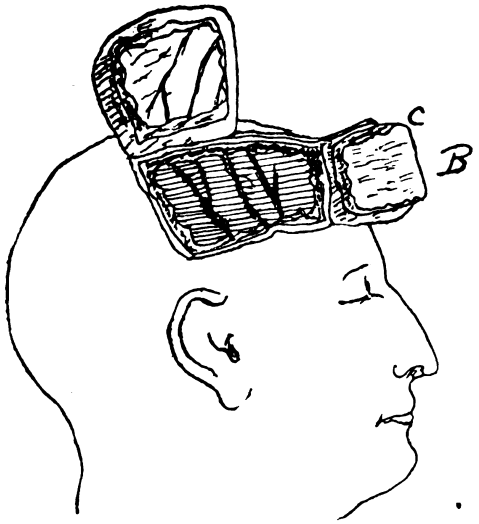


FIG. C 1.—Temporary resection. (Bramaun.) Double flap to enlarge the opening. Flap B must be replaced first on account of its oblique inner border C. (Chipault.)

the manner shown by the accompanying drawing. (Fig. D, D.) In the corners it must be split diagonally a little. When the diploë is reached, a small opening is made by the chisel and hammer down to the dura, and with a narrow gouge a furrow cut out all around, so that the flap is now movable from three sides. This maneuver, complicated as it may appear, is quickly accomplished, if done with some skill. The fourth side of the flap can be simply broken, if the skull is not very thick, or a chain saw or fret saw may be introduced and the bone sawed through. This procedure has several advantages:

1. It prevents pulsation of the flap.
2. There is, as the transverse cut shows, hardly any

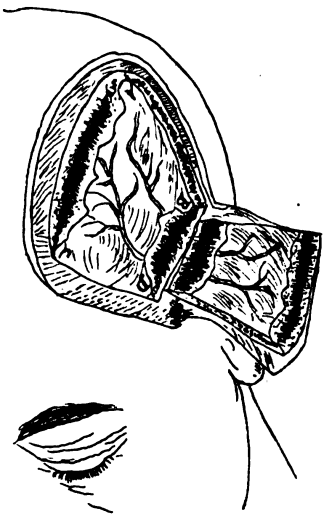


FIG. C 2.—Temporary resection. (Chipault.) On both sides of the replaced osteoplastic flap will remain an open space, A B, C D.

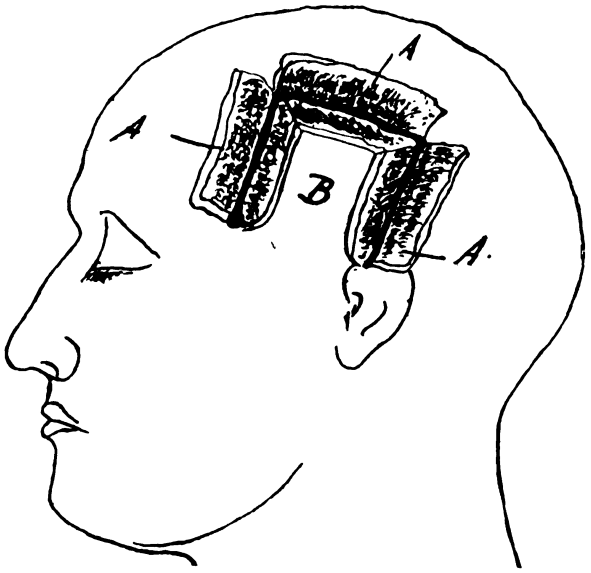
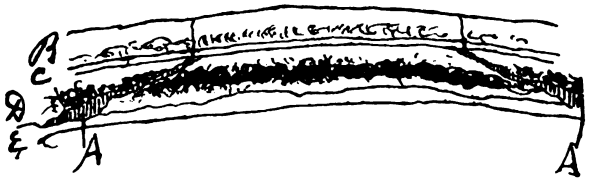


FIG. D.—Temporary resection. (Beck.) A. Obliquely cut and bent up borders containing scalp and skull. B. Flap before turned up.



Transverse section of flap. AA, loss of bone substance; B, scalp; C, periost.; D, skull; E, dura.

loss of substance, and therefore the healing, as in the case of a fractured bone, without much cicatrix, is most probable.

3. The chiseling and gouging is done much quicker, and with much more simple instruments than if the trephine is used and saws introduced by forceps and

were thrown up by exhalation and a wine-colored fluid formed vesicles; necrosis of the epidermis. While the borders acquired a more and more healthy appearance, the central part grew more and more cyanotic, and after about two weeks, it had all the appearance of necrotic tissue to about one-quarter of the thickness of the flap.

To resume, I would say that the central part of the free flap sloughed out, but not to its whole thickness. Thiersch grafts were used to cover the granulating flap. The epileptic seizures recurred, and the patient left the hospital only slightly improved. The bone flap has grown firmly on its place, and the original depression and defect are filled out with bone.

b. Transplantation from a distance. Such transplantation can be either that of bone, periosteum or cartilage.

Periosteum and bone have been taken from the tibia and transplanted with success. The use of cartilage has been suggested by Sacchi, but so far only done on dogs.

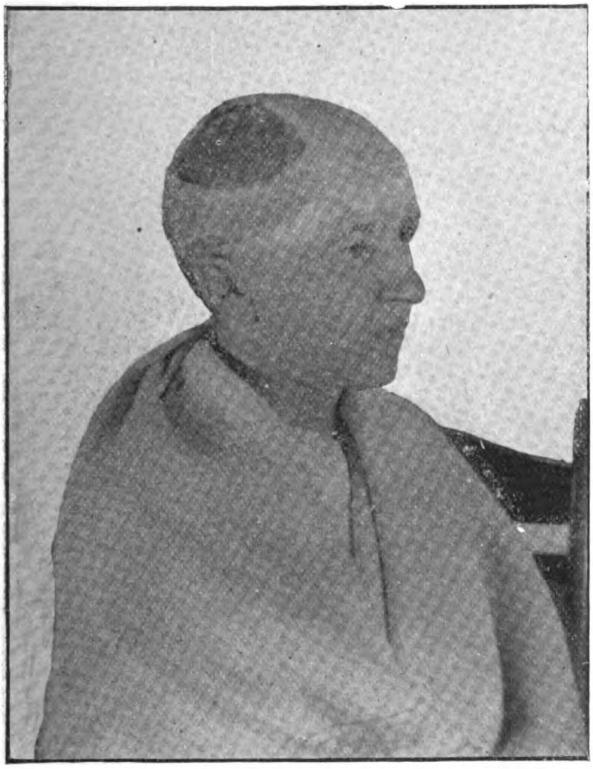


PHOTO. 1.—Josie Chensik, 30 years old. Hekrosis cranii (granuloma supra dur. lust?) defectus cranii 5x4. Before plastic op.

In the Royal Academy of Genoa, on April 23, 1894, Sacchi reported that he had used cartilage bone plates from the epiphysis of a large young dog, into the defect which had been caused by trephination. The plate is implanted two days after the operation, so that the bony part lies on the dura, while the cartilage is underneath the scalp. In three cases in which this procedure has been used, it held in without fail and a complete firm covering accomplished.

4. Heteroplasty.—That means the transplantation of substance from outside of the subject that is operated upon. This substance might be from a living subject (which has been denoted as heterobioplastic), or it might be an inorganic body (heteronekroplastic).

From the experiments and conclusions of later date (Barth and others) we can judge that there is not much difference whether we transplant from a living subject or an inorganic substance. Both are encysted, and if they heal in aseptically, the only difference that can be noticed is, that the organic from the living subject is encysted with much more difficulty than the inorganic. The reason is very simple. The organic substance has to undergo great changes of nekrobiosis while it is implanted, and it is a much more complicated pathologic process to carry away decaying substance, to assimilate living substance of a different composition and histologic texture, than to surround with a network of proliferating cells an entirely unchangeable foreign body.

The experiments which have been made to ascertain the possibility of healing, appropriate for living substance from a different species into the human, are manifold. During the period of aseptic surgery, bone plates especially have been used to cover defects. McEwen has taken the parietal bone with the center of ossification and periosteum of a six-weeks-old dog to cover a defect of the skull. Ricard and Schmitt, have repeated this experiment. The bone plates of a goose's skull have been used by Jacksch and Kapper to cover defects with, they say, good results. But the instances are too few and besides the cases could not be analyzed afterward, to refute the objection that these plates have been disorganized, re-absorbed, and new bone, calcareous deposits have taken place on the previous defect. Chipault questions the possibility of implanting a living heterobioplastic graft and, I would say, rightfully. The very instructive history of the Case Chensik will prove the impossibility to graft a large living substance;—if we can say *living* for a substance that has been taken away from the organism; we might rather call it organic:

Mrs. Josie Chensik; 30 years old; employed in housework; German; widow; has had one healthy child. Husband, as far as she knows, had been healthy. Up to July, 1883, she enjoyed good health. In July, she noticed a swelling on the right side of her head, which grew considerably and finally broke, discharging a large amount of pus. During the same time an eruption on the skin set in, which disappeared shortly afterward leaving no marks. The swelling caused no pain. The opening where the swelling broke enlarged to the size of a 50-cent piece, leaving the bone bare. The neighborhood of that bare place was discolored, and shortly afterward two other places of the same size had sloughed, so that when I first saw her at the Charity Hospital December, 1893, I noticed three ulcerations on the right side of the parietal region, all of the same size. The skin around them discolored, the bone lying bare, and black from use of bichlorid washes. The bone was apparently necrotic, perforated by a hundred little holes of pin-head size, through which came pus of a very disagreeable odor. This was her condition, and made the patient very offensive, nobody being able to bear her presence. In every other respect she was healthy. There was no trace of syphilis; no tuberculosis in her family. On January 23, she was taken to the Post-Graduate Medical Hospital. Temperature 99.2; pulse 102; the wound discharging considerably; strong odor.

On January 26, operated; ether narcosis. The assistant was Dr. Marie White. The head prepared as usual for brain operations. The scalp, as far as it was discolored, removed, together with the periosteum. The bone underneath looked yellowish white; apparently necrotic. After chiseling away and gouging away the necrotic bone, which was of different thickness and arroded inside, a tumor of the appearance of a granuloma presented itself, extending underneath the necrotic bone in ante-posterior direction about four inches; thick in the center and tapering toward all sides. This could be easily peeled off from the underlying dura, except in its central part, where it was quite coherent with the same so that a part of the thickness of the dura had to be removed together with it. However, it did not go through the whole thickness of the dura mater. The bone was gouged away beyond the borders of this, until it was bleeding freely, which symptom showed that it was living bone. There was no demarkation of living and necrotic bone visible. After

probes, as in the methods of Toison and Chipault.

Thus far, I have been able to do this method only on cadavers and dogs, but I will give it a trial in the next case of brain operation. In the dog it is a very hard procedure, on account of the perfect impossibility of chiseling obliquely down to the diploë, the bone of the dog being so irregular in its thickness. In this respect the human skull has a great advantage, especially over the convexity, where these temporary resections are usually performed. Temporary resection will be the operation of choice in the future because, once started, the opening can be made as large as needed and without any loss of cranial substance, as in the case of trephining. Two or three such flaps can be formed, and half of the skull—or more even—laid bare if necessary.

2. Implantation of Cranial Fragments.—This method comprises trephining with replacing the bone plates, as well as the re-implantation of loose fragments in

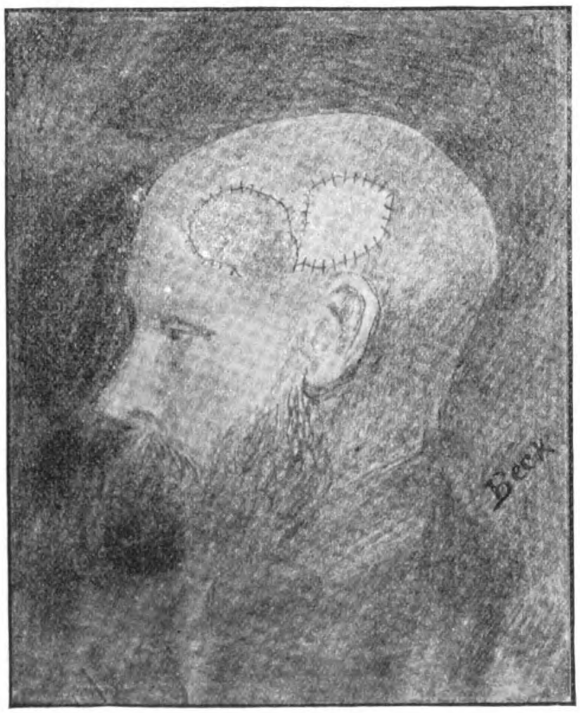


FIG. E.—Bert. Bereman, eight days after operation.

fractures. They both have, physiologically, more or less the same conditions of wound healing. Fragments from fractures, *ceteris paribus*, give even better conditions than the round chips formed by trephine, or the square chips by the chisel and mallet, because the fracture causes a simple breach, while the saw destroys substance between the fragments. The relation between these lesions is the same as between an incised and a ragged wound. The former, if taken under a microscope, will also appear as ragged and lacerated, but the necrosis between the two borders will be much smaller and the substance thrown off much less; the wound healing process, therefore, more simple than in the latter. From this standpoint, I would prefer a chisel and bone-cutting to trephining.

The plastic of this group is done in the following way: The bone is replaced from where it has been taken, more or less unchanged. In many cases, in fact, these bone fragments, though without periosteum have healed in, and there are numerous observations where they have healed in, not in the manner of foreign bodies—that is, encysted—but with perfect integrity of their substance. They have the great advantage over other foreign bodies which are used in their place, in that they have perfect diploëtic circulation which readily takes in the blood from the neighborhood, as well as many openings in the table for new vessels from the dura. Fragments of fractures have very often some connection with the periosteum, and should therefore not without consideration be torn off or out, but carefully adapted, their periosteum sutured, and the condition rendered as much as possible similar to the condition before. To cut the little fragments into small pieces—little chips—may, at the same time render the nutrition easier, because the plasmatic circulation might get harder through a large chip than through a small one but on the other hand, it might endanger the life of that little bone chip altogether, and the chip might cause an irritation which not only causes this one chip to suppurate out, but also prevents the others from taking good strong hold, as I have observed in a case where I used all bone chips, replacing them as nicely as possible; they suppurated all out.

3. Transplantation of Bone from other Parts of the Body.—There are two possibilities again: *a*, transplantation from the neighborhood; *b*, from a distance.

a, Transplantation from the neighborhood, or the so-called autoplasty by the slide of Koënig's which gives so far, splendid results. The method is best described by the following history of a case, whose picture, before and after the operation shows the result:

Bert Bereman; painter; Cook County Hospital, February, 1894. Eighteen years ago this man was struck on his forehead by a rotating crank, and a piece of his skull was chipped out. He was taken to a hospital and a piece of bone, one and one-half inches in diameter removed, and the defect simply left to heal by granulation. A cicatrix which was closely adherent to the dura showing marked depression was the result of this operation. From that time on, the patient had attacks of epilepsy—as frequent as one hundred in a day—and lately so many that he sought refuge in the hospital for surgical cure. The condition before the operation is shown by the photograph. (Fig. D. Photo 3). It was thought that the cicatrix adhering to the dura, and possibly to the brain substance, was the cause of this epilepsy and I decided, therefore, to relieve this scar by dissecting it down to the brain and covering the defect with bone. The scarred tissue was excised at first with the surrounding healthy skin, to the extent shown by the white semi-circular line on the picture. In the center of the free dura mater was a splinter of bone, vertically inserted, which was removed. The incision into the dura was made and the brain underneath inspected. It was found that it was in no place adherent to the dura; that the thin arachnoidæ were whitish and opaque. The blood vessels of the pia mater were somewhat congested but no other pathologic change. The dura mater was therefore, sutured up again, and a flap formed exactly in the manner of Müller-Koënig's suggestion of scalp, periosteum, bone, which was slipped over the defect, implanted carefully, and carefully adapted. A pear-shaped defect with bare diploë was on the place from where the flap was taken. (See Fig. E.) This defect was covered by a free flap which was dissected from the leg of the patient and quickly sutured.

The patient had no attack of epilepsy for a number of days. Müller-Koënig's flap healed by primary union, and so did the free flap, except in its central part, where it sloughed out in the following manner: The borders of the free flap to about one-quarter of an inch, were rose-colored on the second and third day; the central part somewhat paler, but during the following three or four days this central part acquired a pink color. The superficial layers of epidermis

these maneuvers, the defect in the scalp measured five and one-half inches by four inches; the bone defect, about one-half inch smaller. The dura mater showed marked pulsation and threatened at times to break through on the thinned portion. The wound was dressed with iodoform gauze, and the patient put to bed. Operation lasted two hours.

Remarks.—From the appearance of the thickened bone and that granulomatous mass, I was inclined to believe that I had to deal with a syphilitic process, but the microscopic examination left me in doubt. The specimen showed a large amount of spindle cells and new embryonic cells, and even for the well educated eye of a microscopist it would be hard to decide whether the specimen is spindle-celled sarcoma or granuloma. Clinically, the case seemed a syphilitic process; microscopic examination indicated sarcoma. The decursus for the next twelve days, was that of a normal wound healing. Healthy granulation covered the dura and the patient was doing well. Daily dressing. The question arose, how to cover this large defect. The picture which was taken about this time, shows the sloughs that remained after the use of Esmarch's bandage to save blood. (Photo 1).

On the thirteenth day, a second operation was performed,

PHOTO. 2.

and an attempt was made to cover the defect by the method of Müller-Koënig's scalp periosteum bone flap. A large skin flap was formed, periosteum incised, and with the chisel an attempt was made to separate the upper table to the extent of the defect, but after hard work of an hour and a half it was seen that this attempt was fruitless, the bone being as brittle as glass and falling off the periosteum; the bone not of the same condition as a healthy bone through the whole scalp; it seemed porous (hyperplastic ostitis). The flap was sutured therefore on its old place again, and the patient put to bed. The healing was by primary union. Again two weeks passed, and the attempt was made to cover the defect by heteroplasty. A dog's skull was shaved and aseptically prepared. Scalp, periosteum and bone flap, to the size of the defect were removed, but when the trial was made to place the same into the defect—whose granulations were thoroughly scraped—it was seen that the very uneven inner surface of the dog's skull would bring about a very dangerous irritation of the dura and the experiment was abandoned. Two days afterward another attempt was made. At the suggestion of one of my friends, I tried a more even surface; the same being given by the inside of the ribs of a very young dog. A flap, consisting of skin, muscles, ribs (cartilaginous portion), which were very close together was dissected out, the pleura removed, the dura mater of the patient thoroughly scraped, and a fresh flap of the dog, with the raw surface of the perichondrium of the ribs implanted, and the perfectly approximated borders sutured together. No rise in temperature consequent upon the operation, but on the third day, a very offensive odor indicated that the flap had become partly necrotic, and though some portions of the same seemed to indicate a close coherence and some vitality—bleeding when removed—I was obliged to abandon this experiment, to remove the flap.

The patient, though better, left the hospital on the forty-third day, the defect being protected by a firm dressing, but shortly afterward she returned again, being afraid to do the slightest work from fear of perforating the thin membrane covering her brain. Nothing seemed to remain to be done but to cover the granulomatus dura with Thiersch's grafts, giving to it at least a covering of skin. It had to be scraped again, and the Thiersch grafts took wonderfully. For four

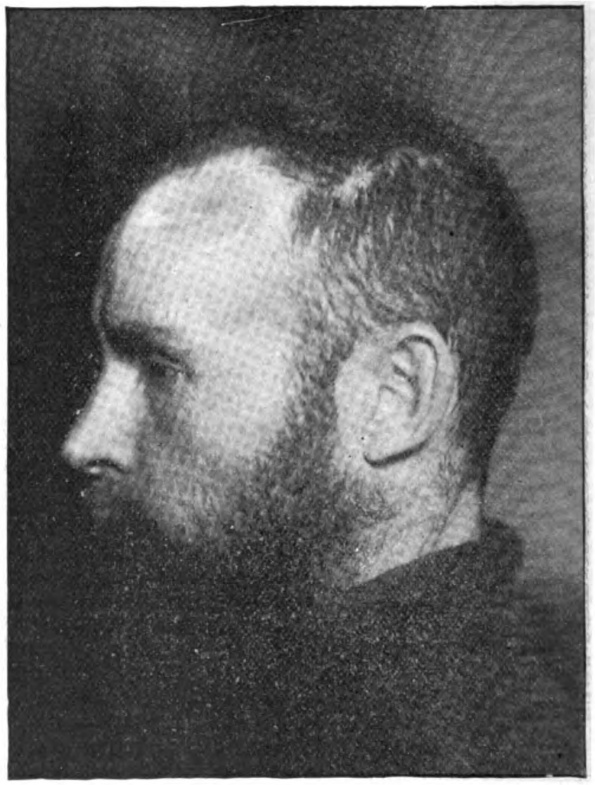


PHOTO. 3.—Mr. Bert Bereman. Epilepsia traumatica, typ. irreg. Defect. cranii indeut. trepanatis taris. Plastic op., (Müller, Koenig, Wagner) with plastic of a large free flap upon denuded surface.

weeks the patient remained in the hospital, after which she returned home. By so often scraping the dura, as we did, this membrane seemed to acquire such a thickness that it seemed to me to give more protection against insult than ever before. The patient came at regular intervals to my office, giving me the chance of watching the remarkable process of regeneration of bone between the Thiersch grafts and the dura. Each graft looked like a fish scale, and that it was not retracted, connective and hardened tissue which gave this firmness, was shown by an incision in two places within the boundaries of the previous defect where I could remove two particles of bone which had newly formed. These little scales of bone closed together and at present the defect is covered to two-thirds of its extent with true bone. There is yet some movability between these plates, but gradually less and less, and the bone is getting unevenly thicker, too, as can be seen on the photograph which gives the final result. (Photo 2).

Resumé.—We had to deal here with a post-operative defect of the scalp, which had closed by reproduction of bone over the dura mater, which has acted here as true periosteum. This repair of bone might be due to that irritation of the dura which has been caused by the frequent scraping of the same.

a. The only possible, but, as it seems for larger grafts, imaginary change of such grafts seems to be the hypothetical possibility to engage circulation through preëxisting channels and use the preëxisting bone structure for protection. But rarely such a circulation in an efficient manner would be established, and decay of even such a tissue as bone, that does not require very much nutrition, would take place and it would be exfoliated, if not re-absorbed. I would therefore, reject, *a priori*, the use of any animal grafts for covering of bone defects.

b. A transition from the animal graft to the entirely inorganic, is the graft of decalcified bone. Kümmel has used such decalcified bone, the preparation of which for this purpose is well known (1891). The very extensive, very careful researches of Dr. Senn about the use of decalcified bone plates and decalcified chips as filling material for cavities of bone, would suggest this material for plastic processes on the skull if they would not share, more or less, the disadvantage of the previous material—the animal grafts. Decalcified bone is, in some way, a substance that can be re-absorbed. It may leave particles which are furnished with new circulatory vessels and therefore encysted. They might become the seat of calcareous deposits but they might be absorbed entirely, and they might act, by decay, as irritating material.

c. The oldest methods, that of transplanting entirely inorganic metallic plates, have been used in some cases on a human. With best results has been used a material that has been recommended by Fraenkel in 1890, and since that time used by Eisensberg, Hinterstoisser, Berger and Potempski. That is the celluloid plate. But inasmuch as this celluloid plate in some cases has been exfoliated or had to be removed on account of accumulation of pus underneath, and inasmuch as it was rather irksome to form and cut a plate exactly corresponding to the defect, it seemed to me worth while to go into some detailed experiments in this direction, the results of which I will now communicate.

In No. 9 of the *Centralblatt für Chirurgie*, Martin of Kölm, has reported some experiments of filling cavities of bone with dead material. He used plaster-of-paris and gutta-percha for filling of bones. I have, according to his experiments, used these two materials and some others to fill out defects of the cranium.

Experiment 1.—Plaster-of-paris powder which has been exposed to dry heat in a test tube was kept ready. At first a plate of about half an inch square, on a dog's parietal bone, was chiseled out. This defect was filled with plaster-of-paris, which soon formed, with that slight moisture of the transudation from the defect, a very hard cover which not only filled out the defect perfectly, but also was immovable from the first start, so that when the periosteum had healed over it, it looked almost as normal as before. There was no reaction of infiltration in the neighborhood of this defect. The experiment was made the end of March, 1894.

Experiment 2.—A dog was operated on in this manner: A one-inch square defect in his parietal bone was chiseled out. Gutta-percha plate, as it is used by dentists, was heated in a watch crystal and pressed in, filling out the defect in every pore of the bone, the periosteum drawn over it and the wound sutured. Three weeks afterward, the dog was killed and the following was found: The dura mater on the inside did not show any difference. When drawn off the bone it was found that the plate of gutta-percha had a smooth surface covered with very fine membrane of connective tissue, through which the color of the gutta-percha was transparent. From the outside through the skin, the place could hardly be felt where the gutta-percha was implanted. Encysting structure of fresh connective tissue seemed to have formed between the periosteum and the plate, the result of the implantation or filling being as satisfactory as possible. The plate had been made aseptic by heating before use.

Experiment 3.—A dog operated in the same manner as the first one; an accident produced a heavy hemorrhage from the sinus longitudinalis, which seemed to be uncontrollable. The dog had lost considerable blood, when I employed the filling of plaster-of-paris, which formed, with the blood, a crust that hardened, and checked the hemorrhage in this way. The periosteum was drawn over and the dog, which seemed to the spectators, almost dead when taken off the operating table, rallied wonderfully and is still living. The plaster-of-paris healed in five weeks after the operation.

Experiment 4.—A dog operated in the same manner as the second one; a large defect of an inch and a half square produced and filled by gutta-percha plate. The result is union, the plate encysted and healed; the dog still living. Details since the operation, same as in Experiment 3.

Experiment 5.—Large dog operated in the same manner as Experiment 3, the defect filled out with sealing wax; primary union. The sealing wax encysted; the dog still living.

From these few experiments which gave so uniformly good results, I am very much encouraged to use the materials just mentioned—plaster-of-paris, gutta-percha, sealing wax, celloidin—for plastic purposes in the human in future. They have the advantage that they can be made perfectly aseptic, can be easily procured and always ready, can fill out the defect perfectly and without leakage, and give strong enough protection. The indications in regard to material and method of plastic on cranium, I would formulate in the following manner:

a. Autoplastic is to be used preferably in all possible cases. There should be removed as little as possible of the cranium, and temporary resection in the most efficient way be preferred to any other proceeding.

b. In case of the impossibility of autoplasty, heteroplasty with gutta-percha or plaster-of-paris might be used to great advantage.

c. In rare cases, bone is formed from the dura mater, but we should not rely on such occasional possibility.

Woodman, Spare that Tree.—The Forestry Association of Wisconsin has taken steps to actively push their bill to save the Wisconsin forests. The proposed bill provides for the withdrawal of all forest lands from sale, and will place certain restrictions on cutting timber.